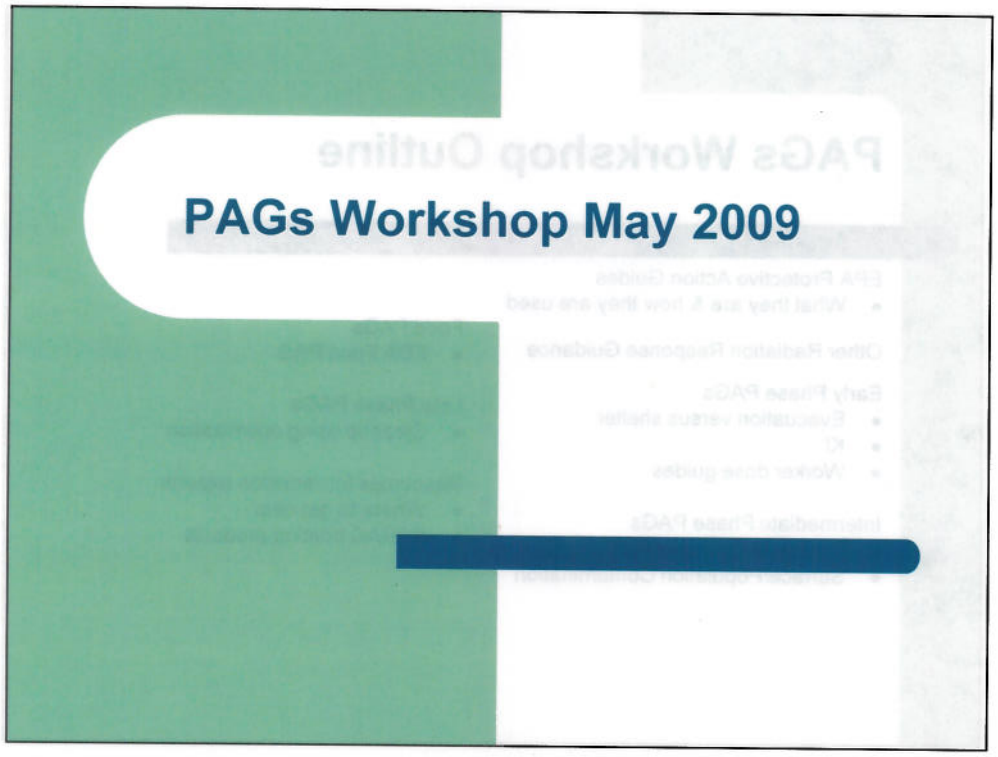
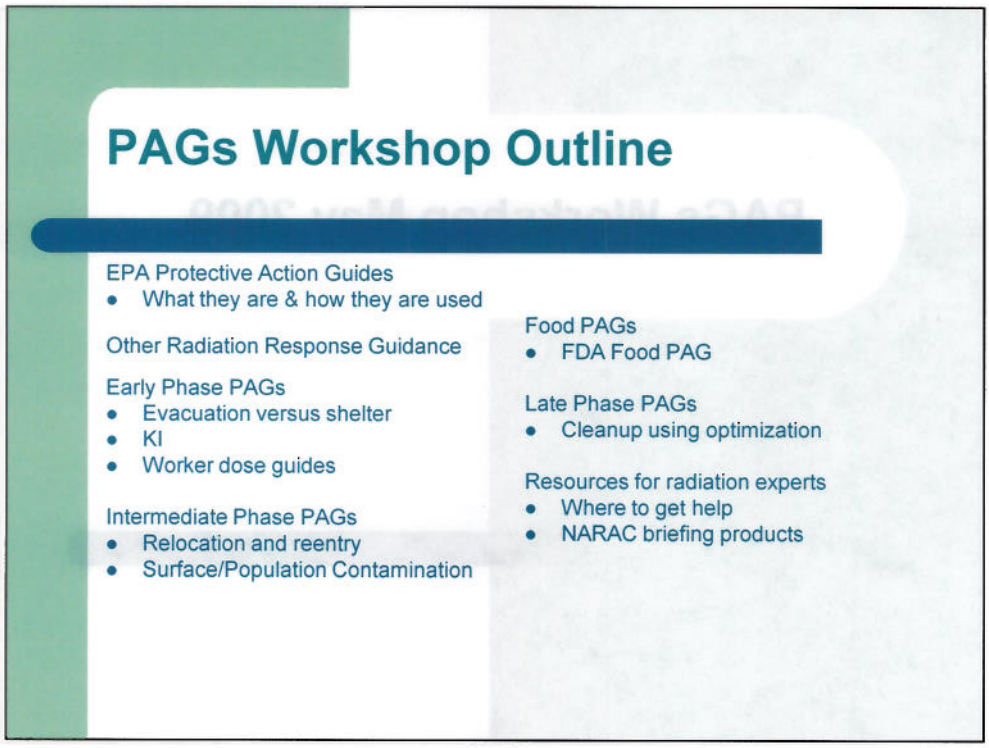
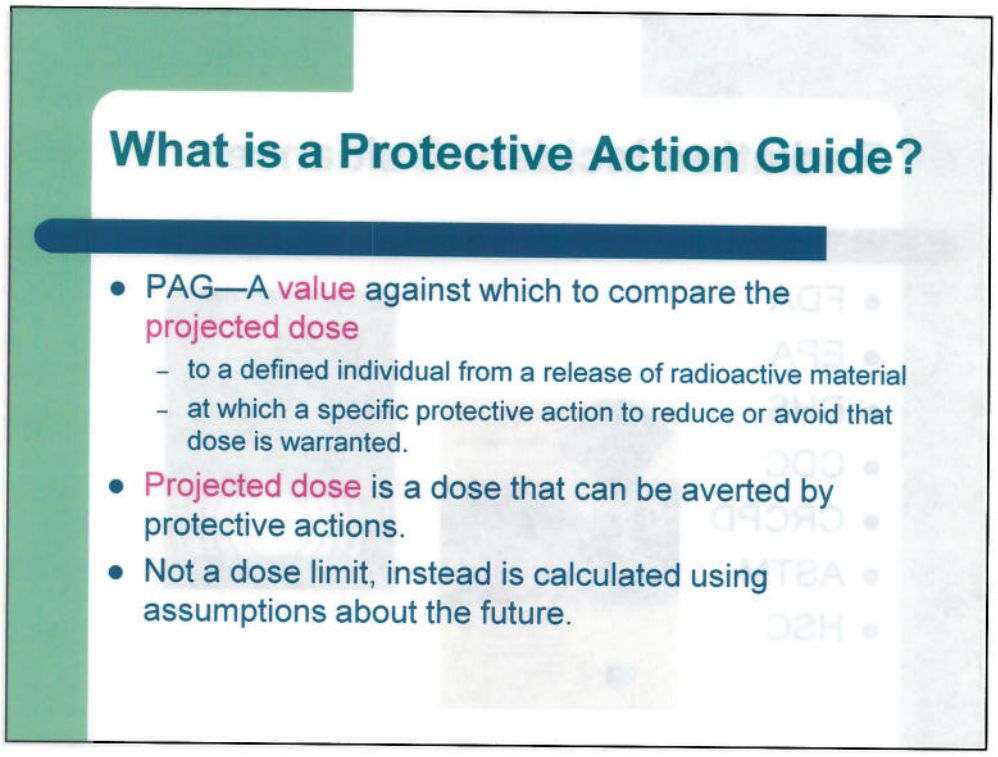


Introduce both speakers – Sara and Jessica



We are going to mention various guides out there, then go through each part of the draft PAG Manual.
-We'll define what's meant by the terms Early, Intermediate, and Late Phase
-And we'll name some resources for help when questions about PAGs come up

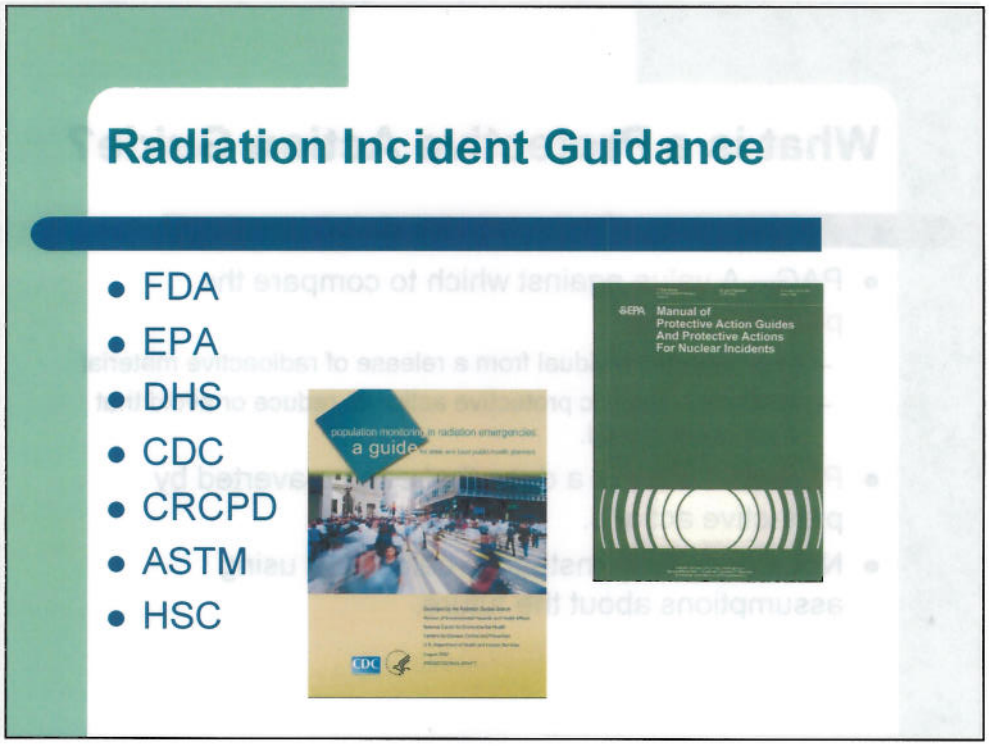


Dose is not measurable with instruments or samples, it is calculated

Calculate projected dose (can't be measured)

Move, shelter, or protect people before the dose is received

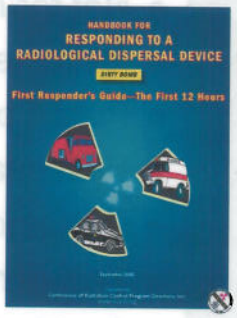
Decision-makers compare estimates of projected dose with the appropriate PAG to determine what actions to take.



FDA, EPA, and DHS have provided "PAGs" proper – When EPA was formed, we got the authority and responsibility to advise the President and the government on 'safe' levels of radiation. We do Federal Guidance for the public, PAGs…
DHS/FEMA RDD/IND – applies PAGs to RDDs and INDs
FDA KI guidance – only about KI, which would only come into play in the case of an iodine release (nuclear power plant, nuclear detonation, …
FDA Food PAGs – applies only to foods (as eaten – without peels, after washing) whether in the field or processed – USDA and FDA use the same guides
Other guides provide implementation guides about specific challenges like population monitoring and decontamination…

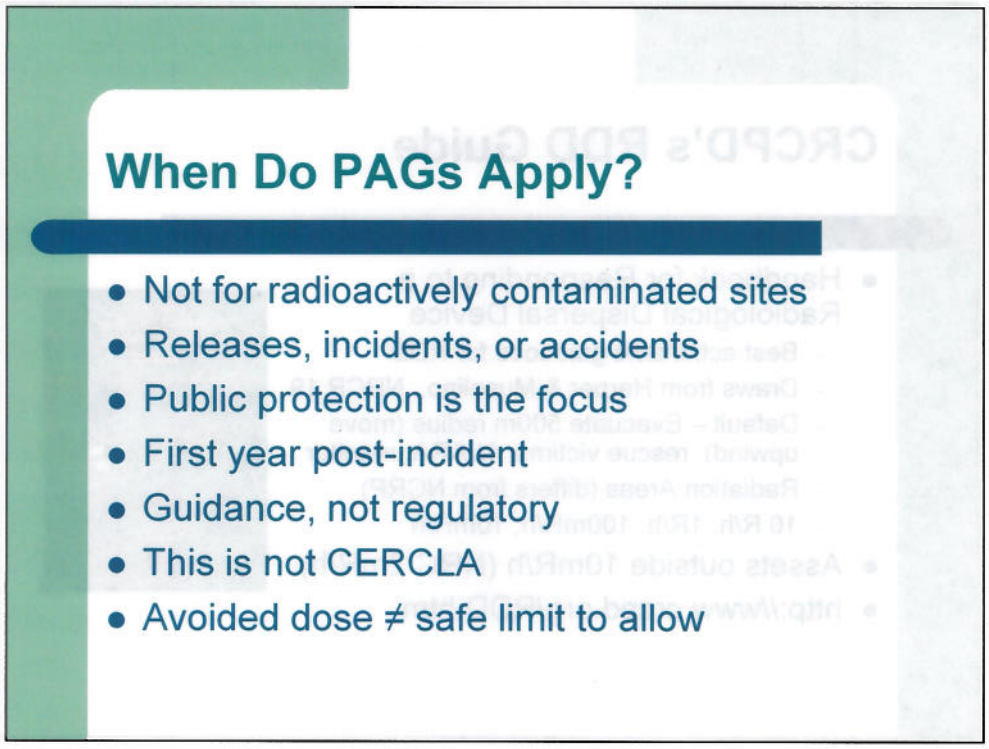
CRCPD's RDD Guide

- Handbook for Responding to a Radiological Dispersal Device
  - Best actionable guidance for RDD
  - Draws from Harper & Musolino, NRCP 19
  - Default – Evacuate 500m radius (move upwind), rescue victims, ALARA, monitor
  - Radiation Areas (differs from NCRP)
  - 10 R/h, 1R/h, 100mR/h, 10mR/h
- Assets outside 10mR/h (NRC 2mR/h)
- http://www.crcpd.org/RDD.htm



•This Guide from CRCPD focuses on the first few hours when state and local responders might have to take action with many unknowns – it provides a default evacuation radius and incorporates some of the best studies and information.

-It can be downloaded for free from the web and also has a fold-out pocket guide.



Releases, incidents, or accidents - When I worked in Michigan and found a leaking radium industrial gauge, the level near it was 100s of times background, while exciting, the source was easily shielded in a drum so we didn't evacuate Detroit ☺

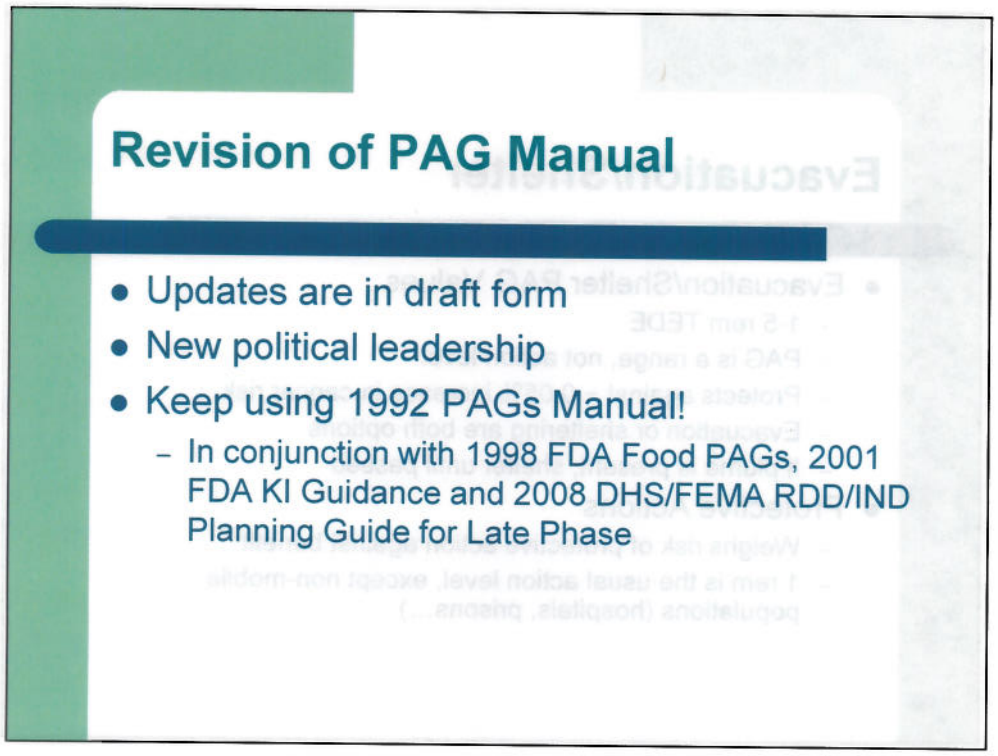
Public protection is the focus

First year post-incident

Guidance, not regulatory – states and locals tend to use it for nuke plant drills, but they don't have to. EPA is not the decider, locals are. We can just help out.

Avoided dose ≠ safe limit to allow

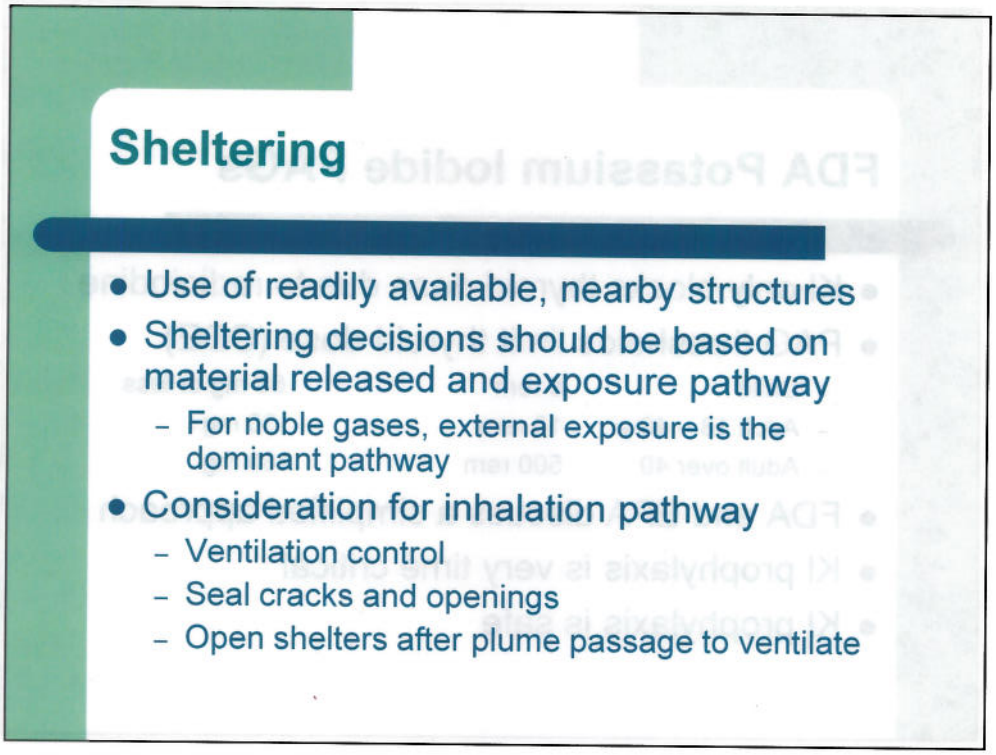
In fact, we can calculate projected "Possible" radiation doses for any time frame right away on day 1, using assumptions and forecasting software.



We have lowered the projected thyroid dose for the administration of stable iodine based on data from the Chernobyl accident from FDA's guide.
The draft revision includes newly proposed drinking water guidance, as well as long-term site restoration guidance from DHS.
Finally, the guide updates the dosimetry from International Commission on Radiological Protection Publication 26 (ICRP 26) used in the 1992 edition to the more recent ICRP 60 series.

Evacuation/Shelter

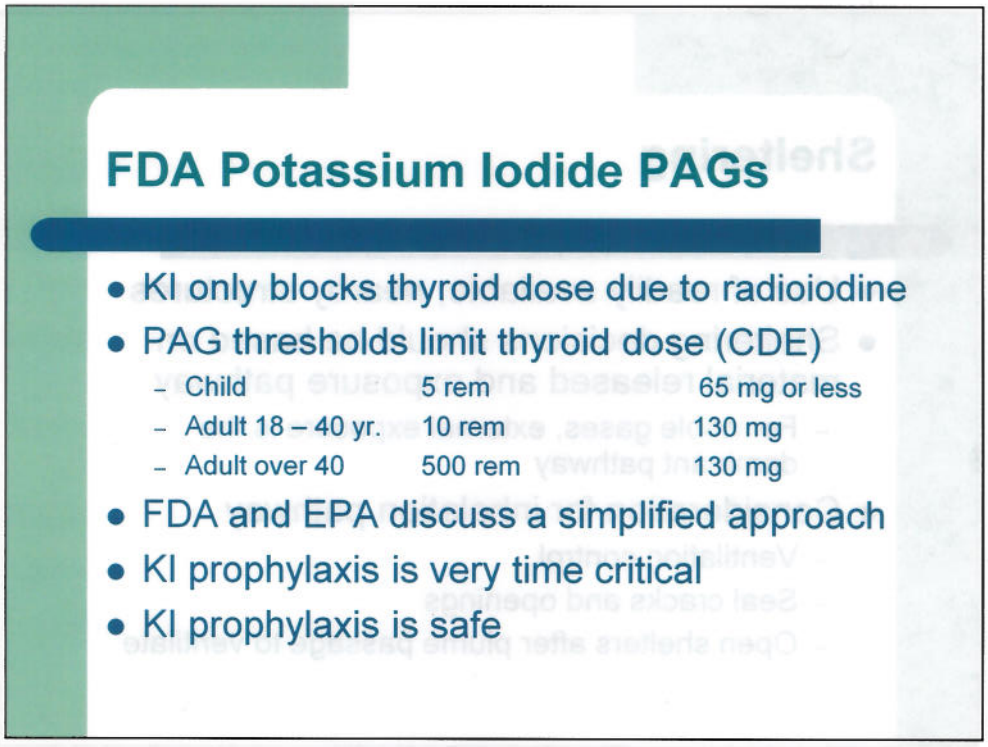
- Evacuation/Shelter PAG Values
  - 1-5 rem TEDE
  - PAG is a range, not action level
  - Protects against ~ 0.05% increase in cancer risk
  - Evacuation or sheltering are both options
  - If plume is present, shelter until passed
- Protective Actions
  - Weighs risk of protective action against benefit
  - 1 rem is the usual action level, except non-mobile populations (hospitals, prisons…)



Sheltering also has the goal of reducing public exposure to the radioactive materials in the plume. Unlike evacuation, sheltering does not involve moving people away from the plume, but rather shelters them in readily available, nearby structures. Depending on the type of material released and the exposure pathway, sheltering offers a less disruptive and less expensive option for reducing risk. It may also be much easier for a local community to implement than an attempt to evacuate all of its residents. There is very detailed information in the revised manual on this subject. It is not an easy decision.

In the case of a nuclear power plant incident, the primary pathway of concern will be external exposure to gamma radiation. Exposures via this pathway can be effectively reduced by sheltering. Sheltering can also reduce the potential for exposure via the inhalation pathway, if necessary. The key factors in using sheltering to protect against inhalation of radioactive materials are controlling the ventilation in the structure, reducing the air exchange rate in the structure by sealing cracks and openings, and opening the shelter as soon as the plume has passed to reduce airborne activity that may have become trapped inside the building.

In some instances, decision-makers may choose to administer potassium iodide as a protective measure against thyroid cancer. It is the guidance involving the administration of potassium iodide that has changed since EPA's 1992 PAG Manual.



Note that iodine most likely not involved in dirty bomb (RDD) but may occur with nuclear power plant accident.

Time critical: Best if administered prior to exposure

Limited value after 3-4 hours of exposure

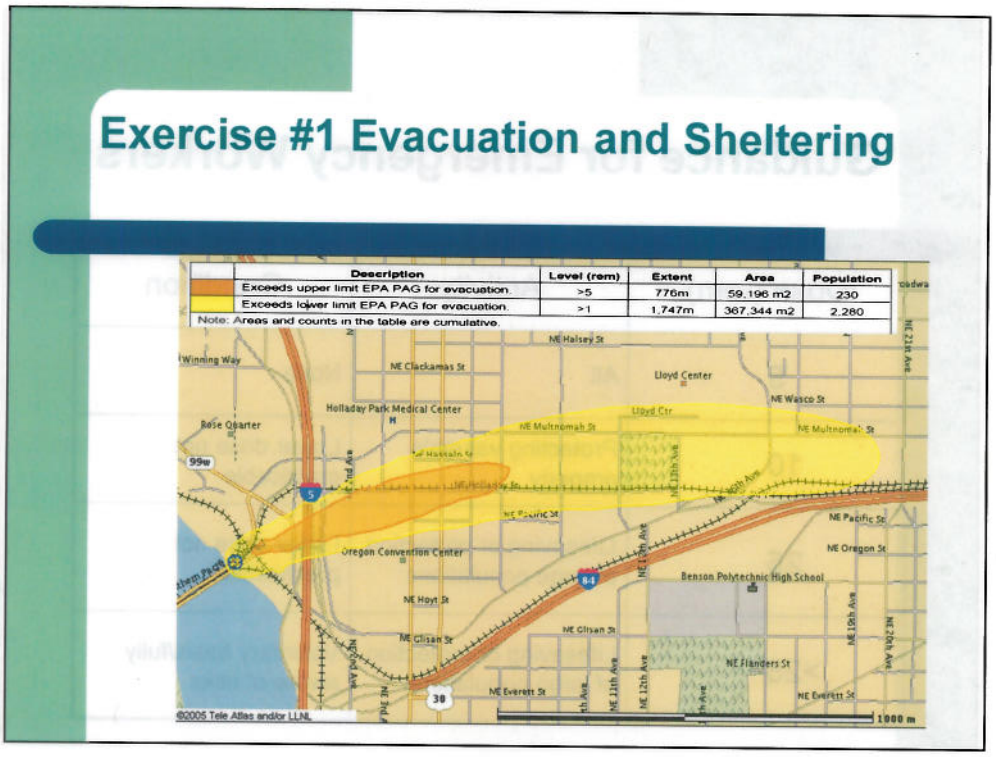
Continue use only if exposure continues

Safe:

Safer for kids than adults

Mostly temporary nuisance side effects

Contraindicated for very few individuals



Exercise #1 Drill or Shelter

This is a NARAC model predicting the area exceeding the EPA Early Phase PAG. It is based on primarily on intelligence leads and very sparse measurements about 12 hours after an RDD detonation.

- Where is the plume?
- What do the contours represent?
- Where should there be evacuation or sheltering?
- How do you choose?
- If both, how do you decide where.
- If sheltering is employed, shelter how long? Why?
- Where are measurements most needed? Why?
- Should additional areas be sheltered?

Guidance for Emergency Workers

Dose (rem)	Activity	Condition
5	All	None
10	Protecting valuable property	Lower dose not practicable
25	Lifesaving or protection of large populations	Lower dose not practicable
>25	Lifesaving or protection of large populations	Voluntary basis/fully aware of risks

-Even though focus is public protection,

-There are dose guides for emergency workers.

One important difference is that these guides apply to doses incurred over the duration of an emergency. The PAGs consider only the future dose that can be avoided by a specific protective action; these guides include all doses received during an emergency. Do dose management to avoid workers hitting their limit and then not being allowed to work in the field. "burnout"

If at all possible, doses to emergency workers should be limited to 5 rem. Higher exposure limits may be justified in the case of protecting valuable property (we mean CI/KR there), saving lives, or protecting large populations. Under rare circumstances, an emergency action may result in radiation doses greater than 25 rem. Workers undertaking any emergency action in which the dose will exceed 25 rem should do so only on a voluntary basis. Such workers must also be made fully aware of the risks involved, including the numerical dose levels at which acute radiation effects may occur, as well as numerical estimates of the risk of delayed effects, such as cancer.

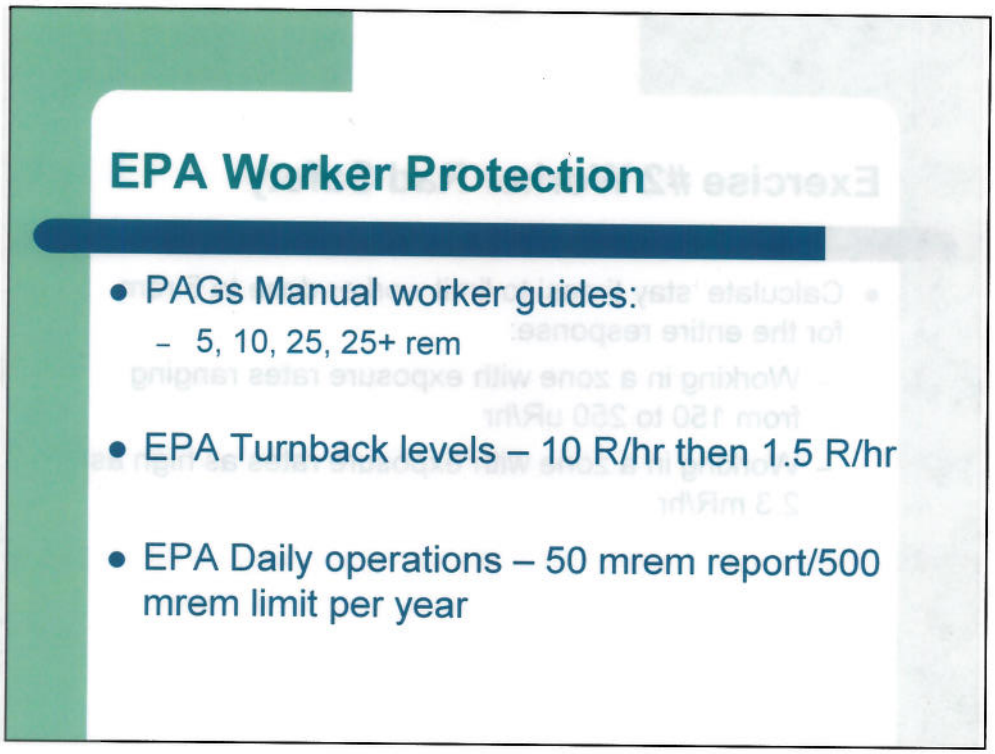
Note that the Occupational Safety and Health Administration (OSHA) says that dose should be limited to 5 rem in any case, but this EPA guidance is in keeping with the Presidential Guidance on dose acquired in performing appropriate emergency actions.

If limit reached, you are getting a desk job

Point out

Customary to use administrative limits

Turn Back Limits & Stay Times apply



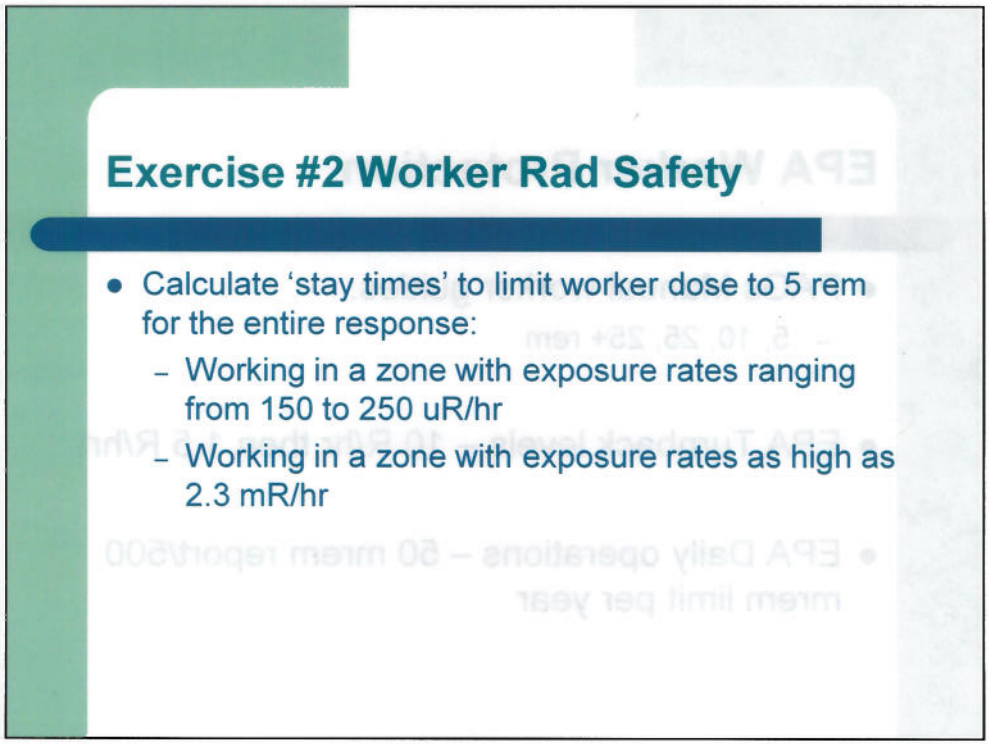
-Most organizations that might do radiation response work develop administrative limits to help ensure they stay within limits or guides

-Since "dose" is not really measurable, it makes life easy to make a certain exposure rate as a turnback level for further decision making about going forward

-As an example, EPA's turnbacks seek to keep EPA responders below 5 rem

-Once a site-specific health and safety plan is in place, we know we can manage doses below our daily operations levels

-If one worker gets that 500 mrem, you need a new worker! Manage doses…



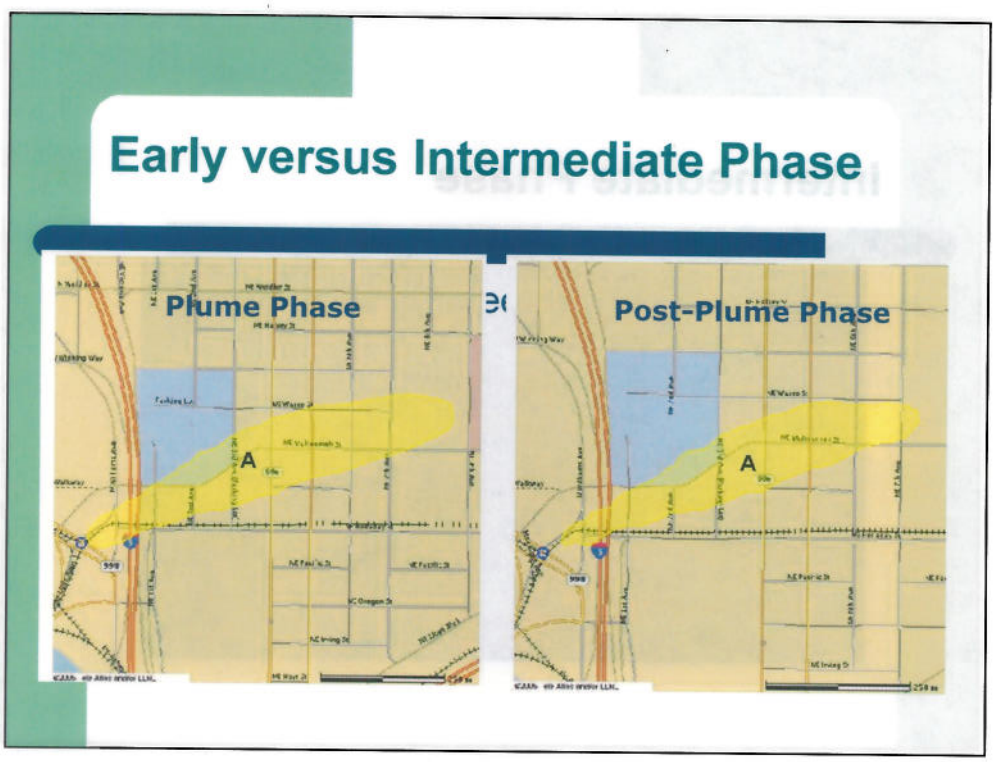
Keep in mind there is more than one way to approach this! There are enough radiation experts in the room to help everyone out with these units.

- Figure out how long workers can stay in the two different zones and stay under 5 rem.

- What questions will you ask to refine your answers?

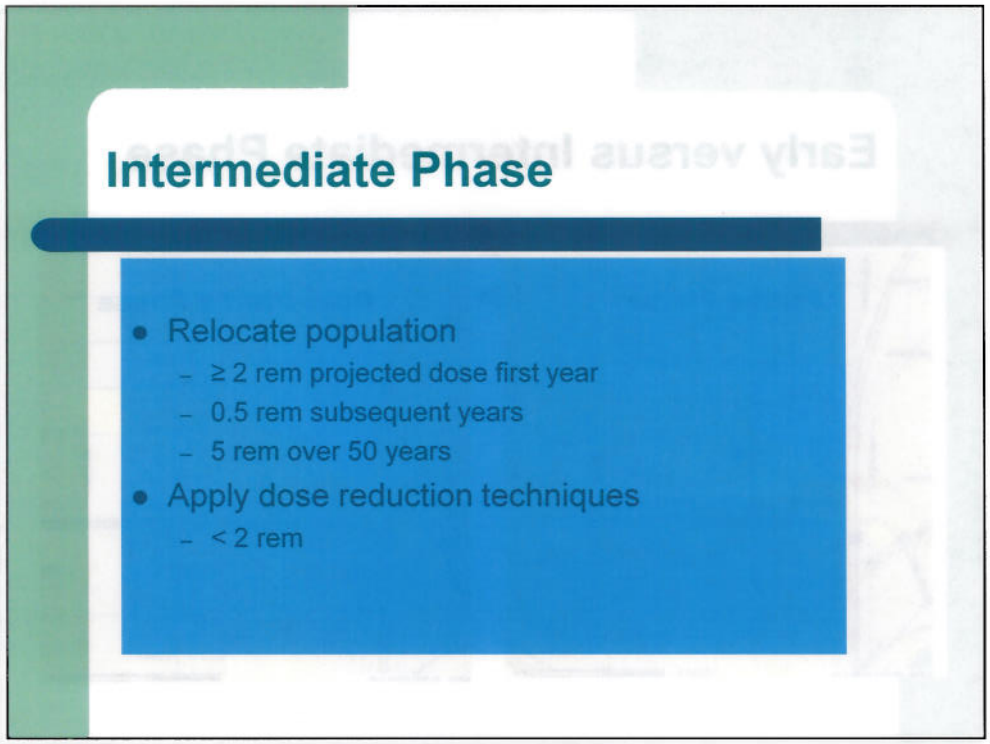
- What are some practical recommendations for the workers to avoid higher doses? You could rehearse the job before going in the zone!

**At all times "less is more" – seeking to keep radiation doses 'as low as reasonably achievable' is a goal…



Three main points about these two plots (from TOPOFF 4)

1. Plume phase means the released contamination is airborne and moving with the wind direction
2. Post-Plume phase means the released contaminants have settled onto the ground (deposition) and the plot shows the 'deposition footprint'
3. Protective actions applied for #1 could be sheltering or evacuation (if above 1 to 5 rem). Actions for #2 could be long term relocation (if above 2 rem first year) until cleanup or natural attenuation has reduced the doses.



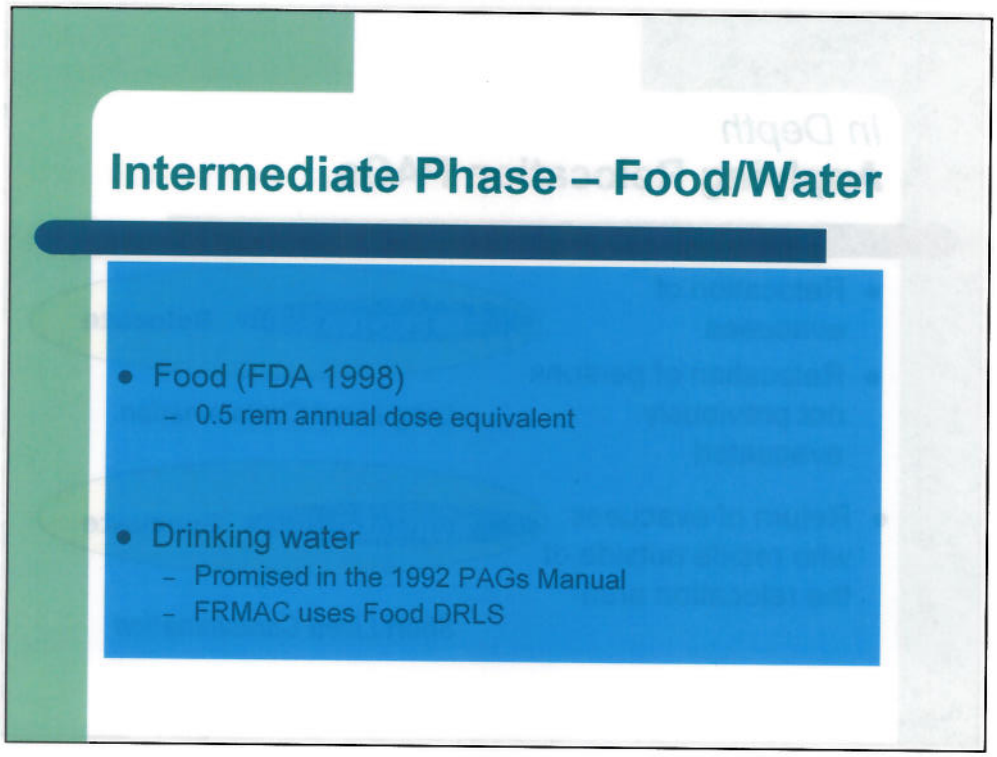
Now that we've discussed sheltering or evacuating populations in the Early Phase, let's move to the next phase

-State or local decision makers will be worrying about when people can come back if they've been evacuated, and about what residual levels of radiation are in areas where people live and work.

-Relocation is the term used here for longer-term moving out of an area, with an assumed first year PAG

-In subsequent years we know cleanup will be reducing radiation doses, along with radioactive decay and weathering

-Dose reduction techniques include washing items and outdoor surfaces, spending more time indoors, etc.

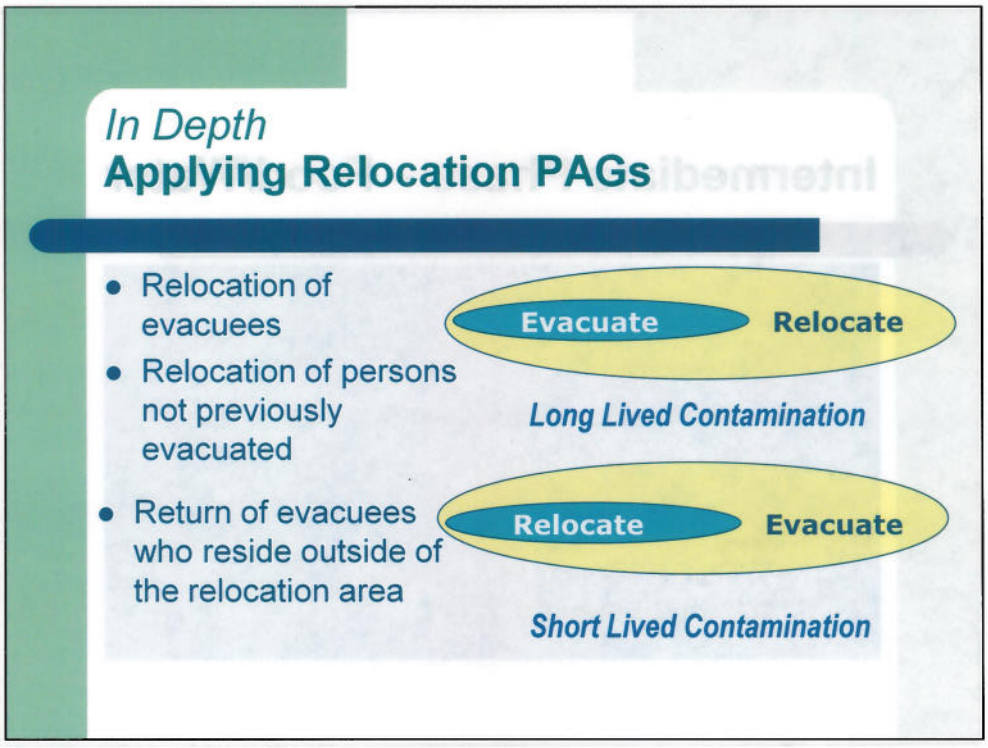


Also during the Intermediate Phase, state and local emergency managers will have to make decisions about whether foods and water are too contaminated to consume

-Food PAGs come from FDA, and we'll talk more about them in a minute

-Drinking Water PAG is just proposed at this point and we're not entirely sure what the future holds for our Drinking Water PAG!

-Informal survey – what does your state do for water samples – compare to FDA Food PAG? Any particular assumptions for RDD versus nuclear power plant scenario?

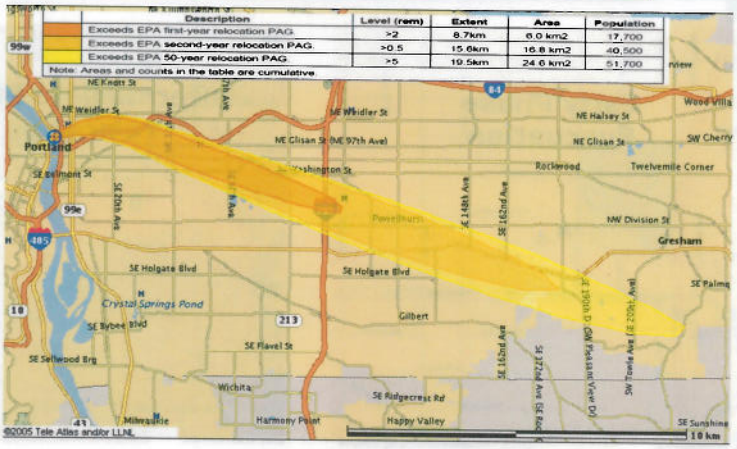


To meet the Intermediate Phase PAGs, it may be necessary to establish a relocation area, which will affect those individuals who live within the boundaries of the area. The creation of such an area is likely to result in three different actions:

Those individuals who were evacuated in the Early Phase, but who reside in the relocation area, must be relocated.

- Those individuals who live within the relocation area, but who were not evacuated during the Early Phase, must now be relocated.
- Those individuals who were evacuated during the Early Phase, and who do not live within the relocation area, may return to their homes.

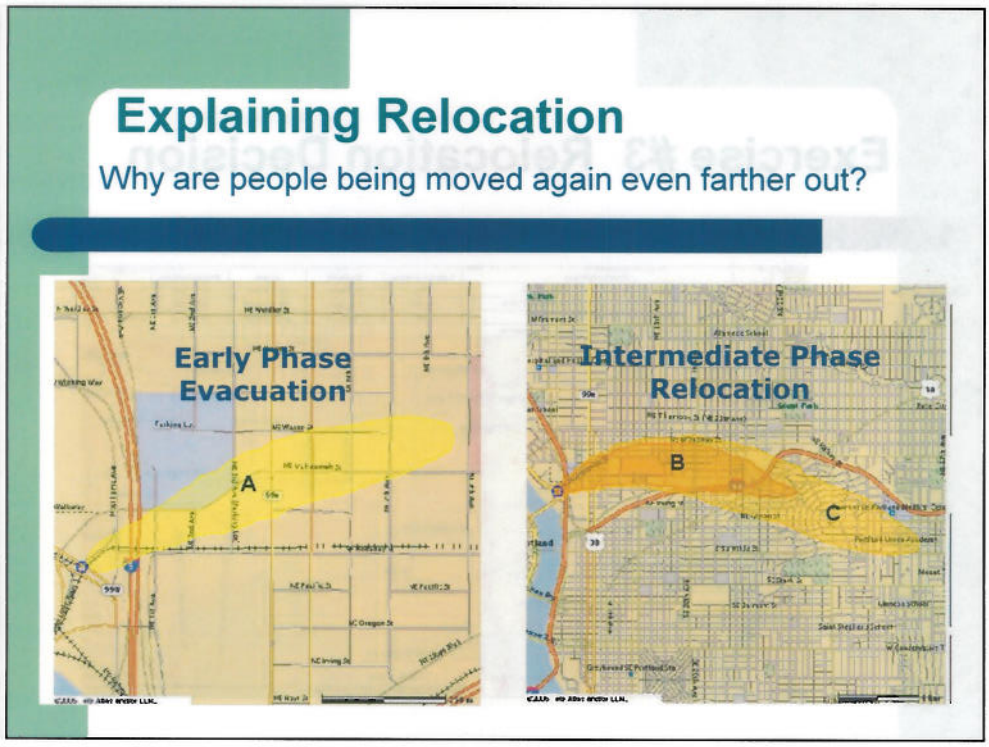
Exercise #3 Relocation Decision



- As a relocation decision is being made, where do the people go? Who provides places to stay?

- Explain avoidable dose (they already may have gotten some dose in early phase)

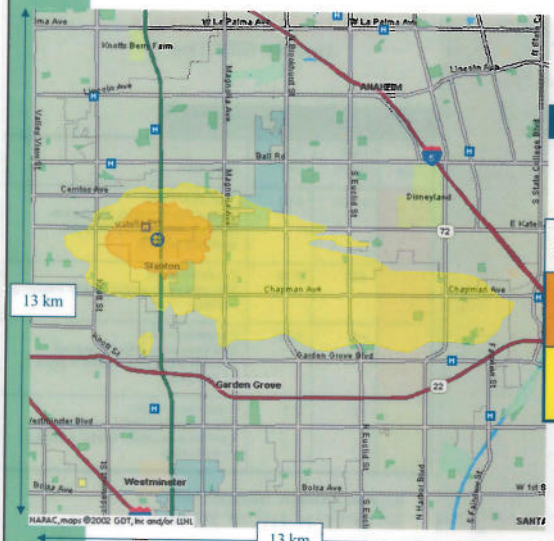
- How long do we have to take the action?



-Write a short explanation on your answer sheet.

-(Sara will interrupt to talk about the Operation Synergy Exercise and the progression of plume plots) – in separate slides!!

Operation Synergy Exercise



EXERCISE USE ONLY

First Day Ground Shine Dose Rate

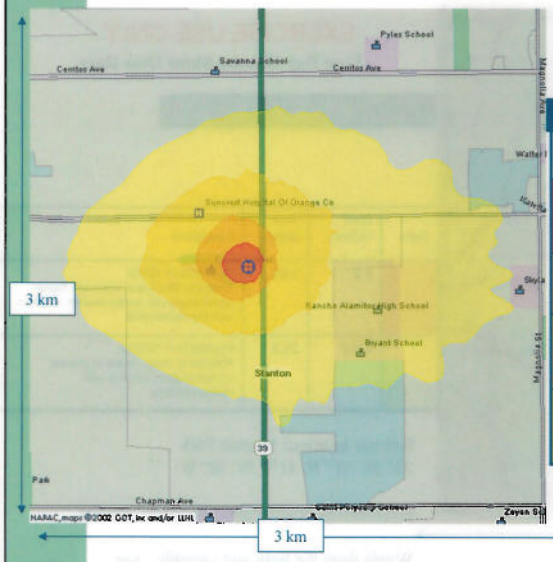
Color	Level (mR/hr)	Area (km^2)	Description
	> 2	3.34	Population = 15300 Potential "Hot Zone" area with higher levels of ground contamination. Confirm with measurements.
	> 0.2	26.0	Population = 105500 Potentially lower levels of ground contamination. Confirm with measurements.

Release location: Stanton Park
33° 48' 01" N 117° 59' 38" W

Hypothetical Radiological Dispersal Device

Winds from the light and variable. See NARAC/Sandia Consequence Report for details

Operation Synergy Exercise



EXERCISE USE ONLY

Four-day TEDE Dose

Color	Level (Rem)	Area (km^2)	Description
	> 100	0.04	Population = 200 Serious Health Effects. Evacuation required. Respiratory protection/ sheltering required.
	>25	0.16	Population = 800 EPA emergency worker limit for lifesaving activities.
	>5	0.75	Population = 4000 EPA Evacuation PAG Upper Limit. Consider evacuation. Shelter in place if no evacuation.
	>1	3.1	Population = 15300 EPA Evacuation PAG Lower Limit. Consider evacuation. Shelter in place if no evacuation.

Release location: Stanton Park
33° 48' 01" N 117° 59' 38" W

Hypothetical Radiological Dispersal Device
Winds light and variable. See NARAC/Sandia Consequence Report for details

Operation Synergy Exercise

EXERCISE USE ONLY

First Day Ground Shine Dose Rate

Color	Level (mR/hr)	Area (km^2)	Description
	>0.33	15.1	Population = 63300 First Year Relocation PAG
	>0.08	65.4	Population = 22800 Second Year Relocation PAG
	>0.03	279	Population = 626000 50-Year Relocation PAG

Release location: Stanton Park
33° 48' 01" N 117° 59' 38" W

Hypothetical Radiological Dispersal Device

Winds light and variable. See NARAC/Sandia Consequence Report for details

Operation Synergy Exercise

EXERCISE USE ONLY

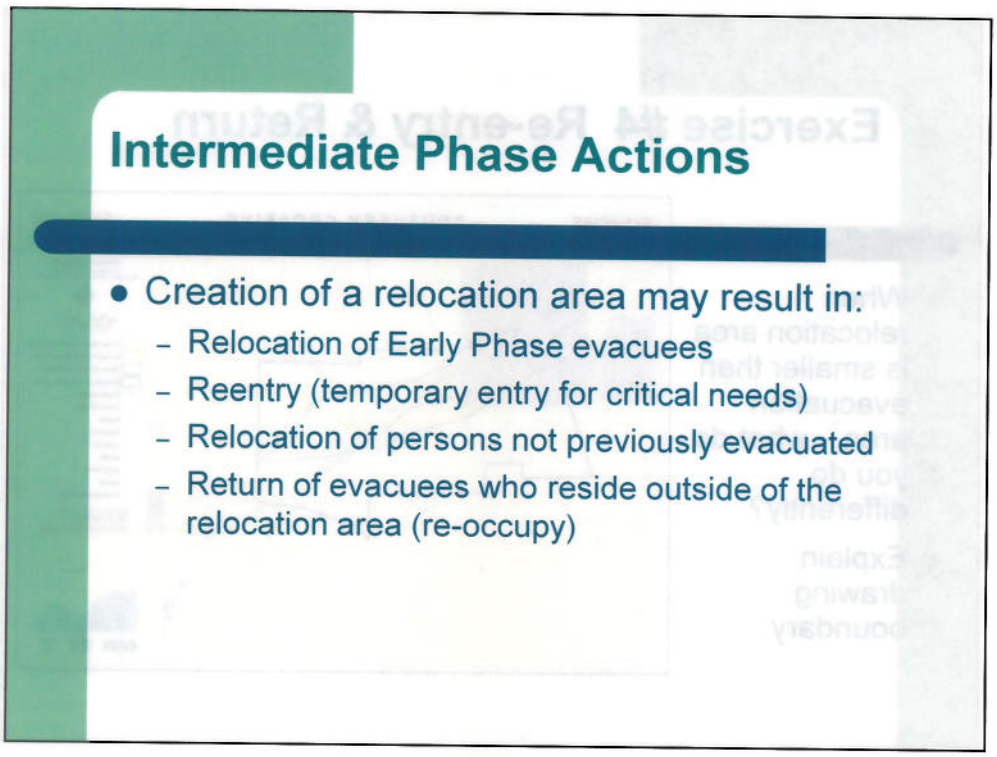
First Day Ground Shine Dose Rate

Color	Level (pCi/m2)	Area (km^2)	Description
	>3.2E5	9694	Population = 2.03E6 Derived Response Level based on FDA Derived Intervention Level for fresh produce
	>1.1E5	33832	Population = 3.30E6 Derived Response Level based on FDA Derived Intervention Level for Milk (grass-cow-infant)
	>8.6E4	42915	Population = 3.41E6 Derived Response Level for Beef

Release location: Stanton Park
33° 48' 01" N 117° 59' 38" W

Hypothetical Radiological Dispersal Device

Winds light and variable. See NARAC/Sandia Consequence Report for details



These terms of art are often used at nuclear power plant drills.

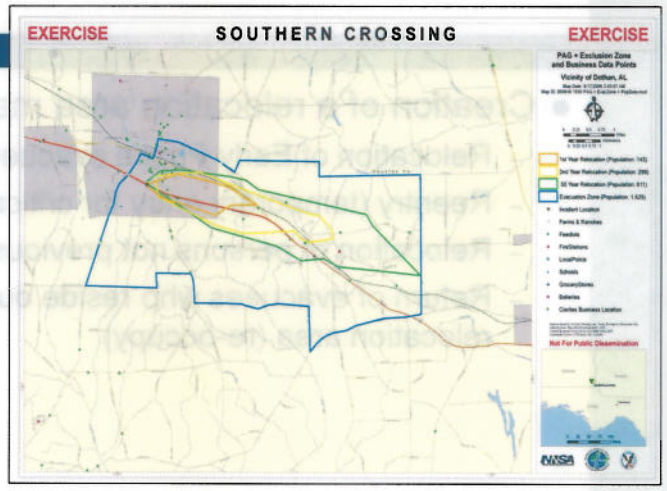
• Those individuals who were evacuated in the Early Phase, but who reside in the relocation area, must be relocated.

• Those individuals who live within the relocation area, but who were not evacuated during the Early Phase, must now be relocated.

• Those individuals who were evacuated during the Early Phase, and who do not live within the relocation area, may return to their homes.

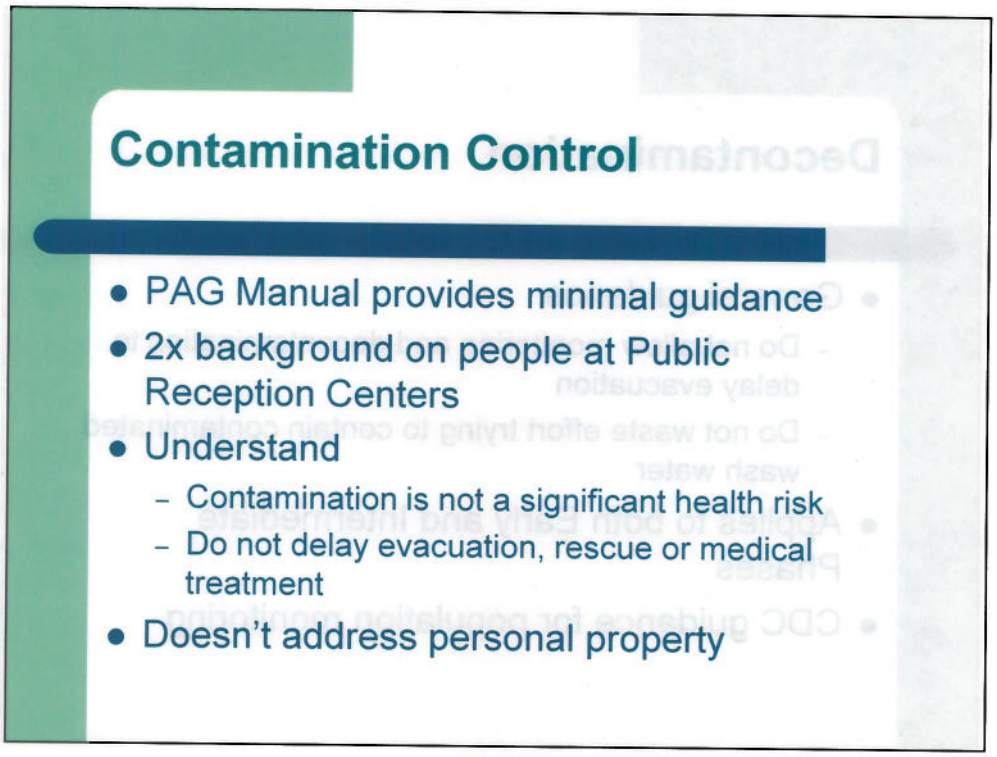
Exercise #4 Re-entry & Return

- When relocation area is smaller than evacuation area – what do you do differently?
- Explain drawing boundary



-Think about how the boundaries were drawn – what logistical concerns will influence these?

-Is there any contamination outside the lines?



During the Intermediate Phase and all this relocating and returning, questions about contamination will arise.

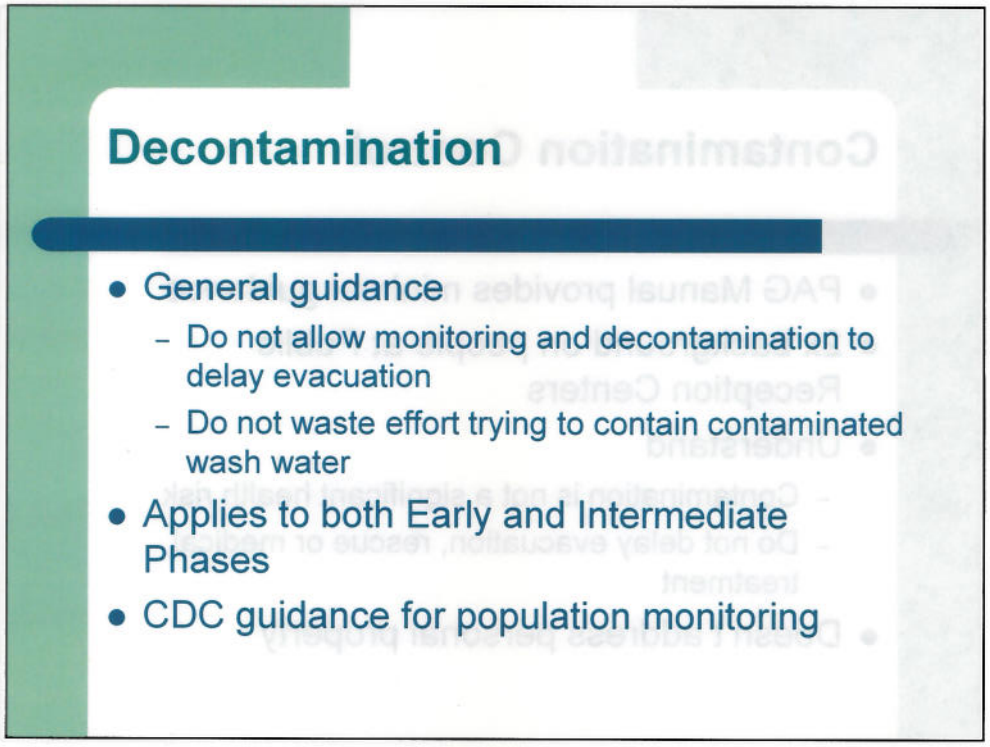
The primary exposure pathways from loose radioactive contamination are:

Internal doses from ingestion from direct transfer

- Internal doses from inhalation of resuspended materials
- Beta dose to skin from contaminated skin or clothing or from nearby surfaces
- Dose to the whole body from external gamma radiation

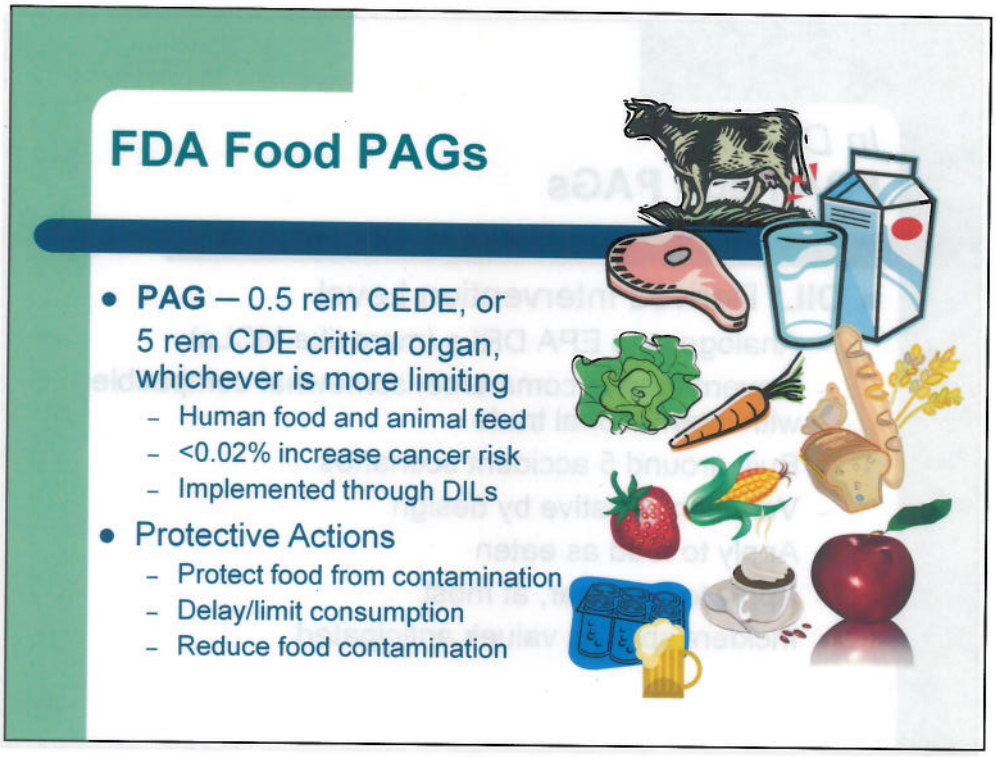
There is only very general guidance for controlling surface contamination both before and after relocation protective actions are implemented—such as setting up monitoring and decontamination stations and establishing auxiliary monitoring in low background areas.

- EPA's mission does not include survey or decon of members of the public!



- Even though public decon isn't in our mission, we might be asked about contamination runoff or controlling the spread of contamination.

- It's a good time to ask for help from the Advisory Team for Environment, Food, and Health since contamination spread is more likely to be an annoyance than a health risk!



FDA PAG applies to human food, of course, and animal feed. The dose limit controls risk to less than 1 in 4,400 increased chance of death by cancer. Because certain organs tend to concentrate certain radionuclides, risk to the most sensitive organ is considered in addition to the whole body. The FDA PAGs are implemented through the DILS (Derived Response Levels). These are computed threshold values analogous to the DRLs. DILs are derived for the most sensitive member of the human population. Much more about DILS in a few moments.

The FDA PAGs offer three types of protective actions:

1) Simple measures to protect food and water from contamination (cover food supply, shelter animals inside, prevent mixture of contaminated and clean food)

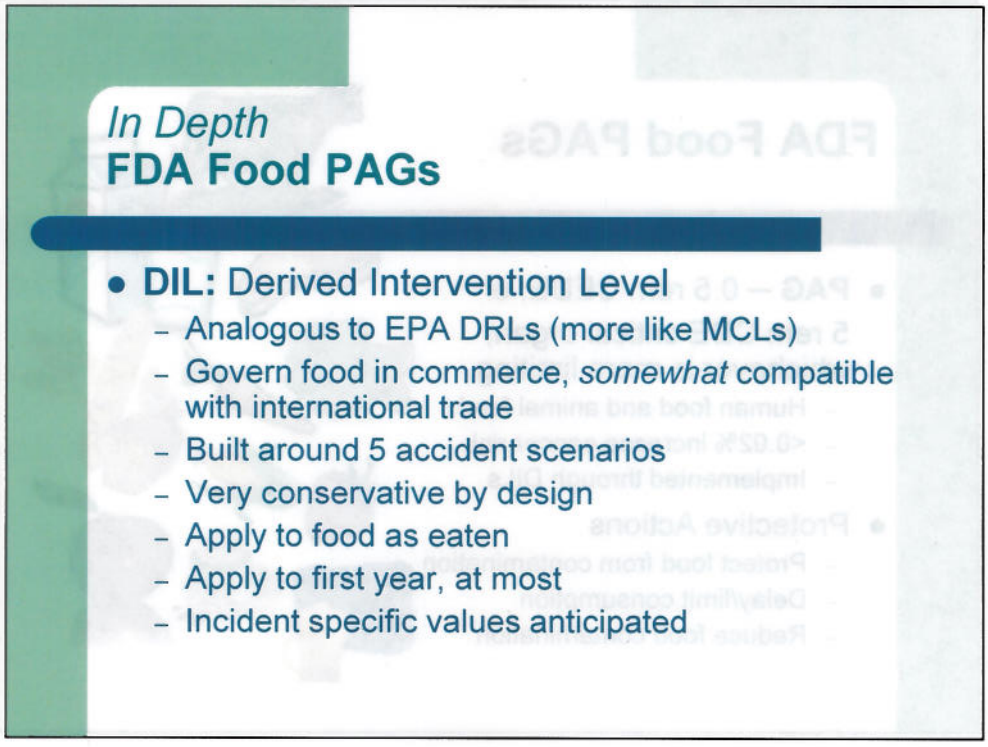
2) Delay food consumption until tested (embargo), withdraw food from commerce that is too contaminated, use stored food instead of fresh food/water sources.

3) Reduce contamination by washing, peeling, scrubbing or just wait for radioactive decay

Problem with embargo is that some foods will degrade while awaiting evaluation or radioactive decay.

The EPA and FDA ingestion PAGs are independent and of food and water consumption are bit more restrictive than chose a more restrictive dose level Using the formula given on this slide for the derived intervention level, the PAG can be converted to units of pCi per kilogram, and comparisons can be made with actual radionuclide concentrations in foods. The PAG may be either 0.5 rem for committed effective dose equivalent, or 5 rem committed dose equivalent to individual tissues or organs, whichever is more limiting.

This calculation for the DIL incorporates the PAG value; the fraction, f, of food intake assumed to be contaminated; the quantity of food consumed in a specific time period, FI; and the dose coefficient, DC, that converts picocuries into mrem.

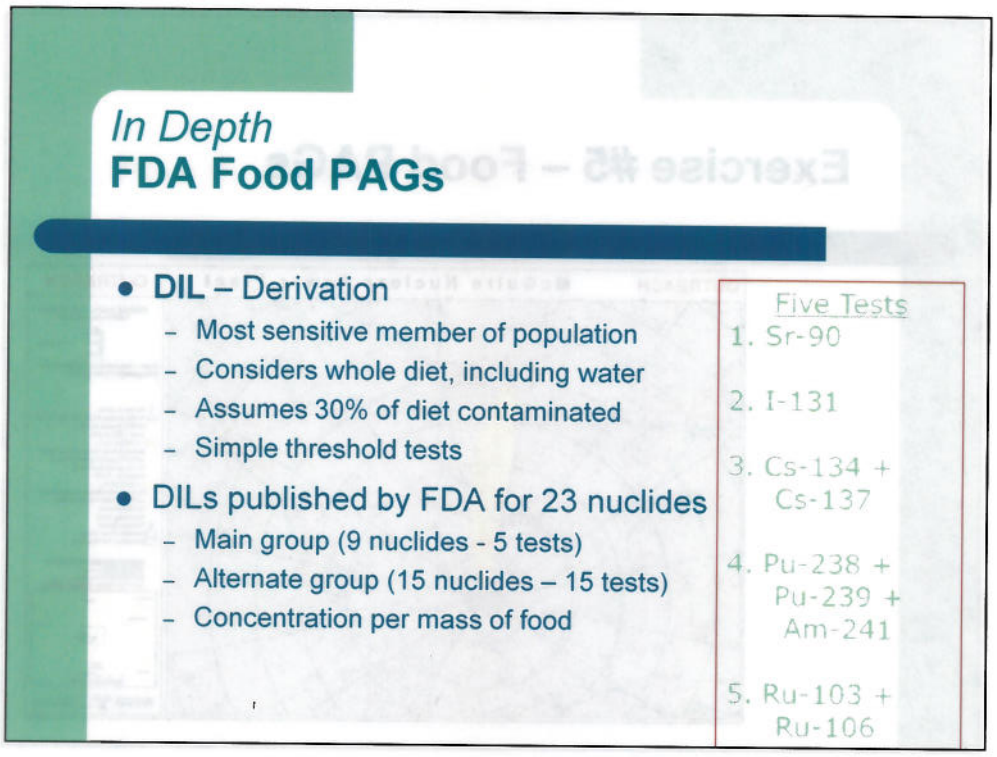


The FDA DILs are analogous to the EPA DRLs ….. The FDA DRLs are intended to govern food and beverages in commerce. In fact the FDA DILS are somewhat compatible with the OILs and DILs… used in Europe. This facilitates international trade. The values are not the same but close for infant (most restrictive). All but 2 or the 9 are with within a factor of 2X.

The nuclides of concern and the tests were selected based on 5 likely accident scenarios: 1) reactor accident, 2) fuel reprocessing accident, 3) waste storage accident, 4) nuclear weapon accident and 5) RTG accident. The resulted in a highly constrained list of radionuclides of concern. By design the DILs are very conservative and will provide adequate safety even if assumptions break down.

The PAGs and DILs are only concerned with food as it is eaten, so contamination on shells, husks or peels can be ignored if not mixed in preparation.

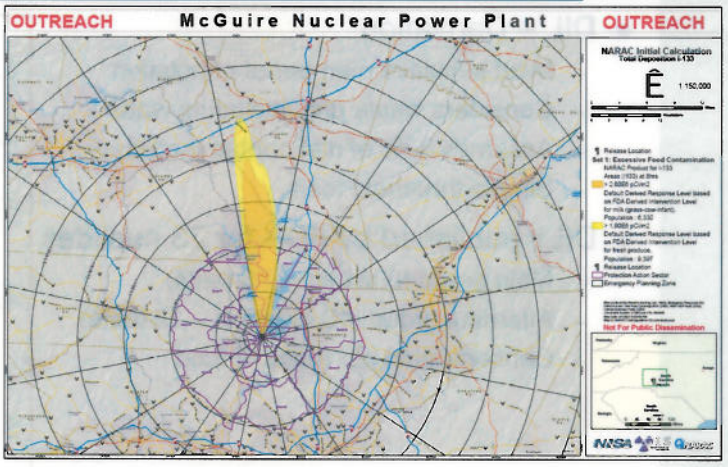
The DIL are intended to be used for only a single season or crop. At most they would be valid for a year. DILs were derived assuming 1 year of consumption, except for short lived nuclides. FDA expects specifics of an incident to be evaluated and anticipates that alternative values might be proposed. If so, FDA must approve them before they can be employed.



The DILS were derived to protect the most sensitive member of the population. Age dependent consumption rates and dose conversion factors were used and even age dependent transfer factors in a couple cases. The most limiting value was chosen as the DIL. The derivation assumed that 30% of the entire diet is contaminated including all water consumed. This is believed to provide at least a factor of 3X conservatism. That water was included does muddy how the Drinking Water and FDA PAGs should be applied. This may stir some controversy.

The result was a set of 23 DIL values to be used in a series of simple threshold tests with no extra calculation. If any one test fails then the food fails to meet the FDA PAG. The main DILs are a set of 9 radionuclides and 5 test. (EXPLAIN). These are expected to be the only significant radionuclides in the five accident scenarios considered. A separate table offers another 15 for instances of the 5 accident scenarios that are out of the ordinary. If the food contamination involves radionuclides other than those considered in the five accident scenarios, then values equivalent to the DILs must be calculated using the FDA method. FRMAC can do that. However, their use will be subject to FDA approval. DILS are in units of activity per mass (pCi/gr, Bq.Kg…).

Exercise #5 – Food PAGs



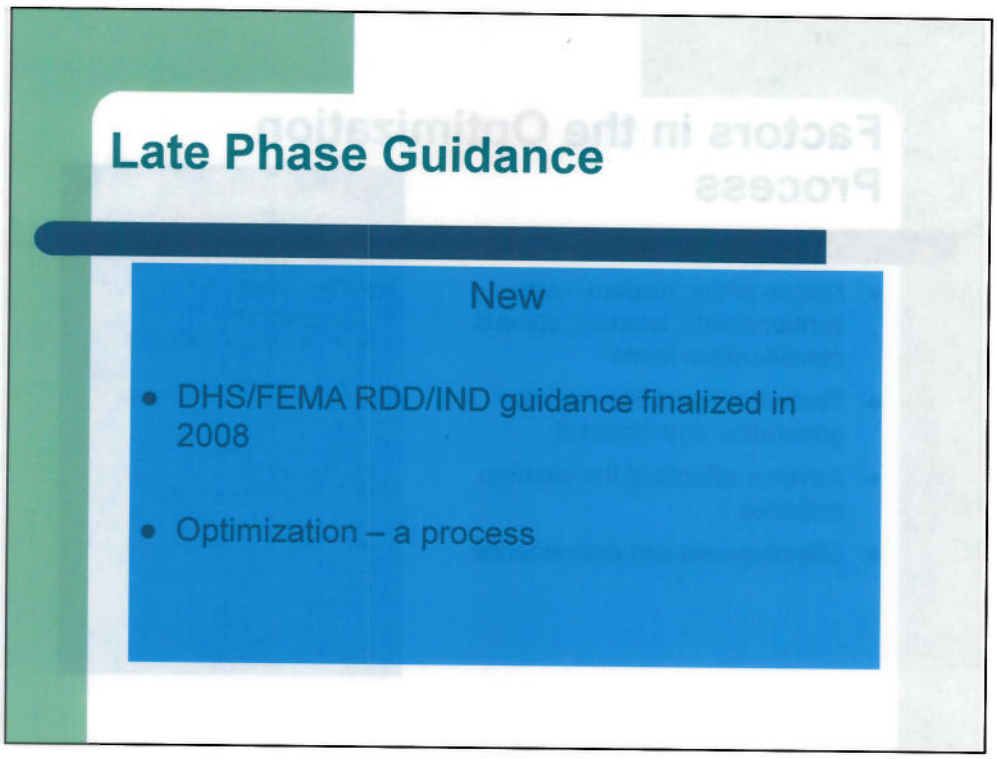
What are potential protective actions?

Embargo:

- Pros?
- Cons?
- How long?
- Who decides?

Sampling:

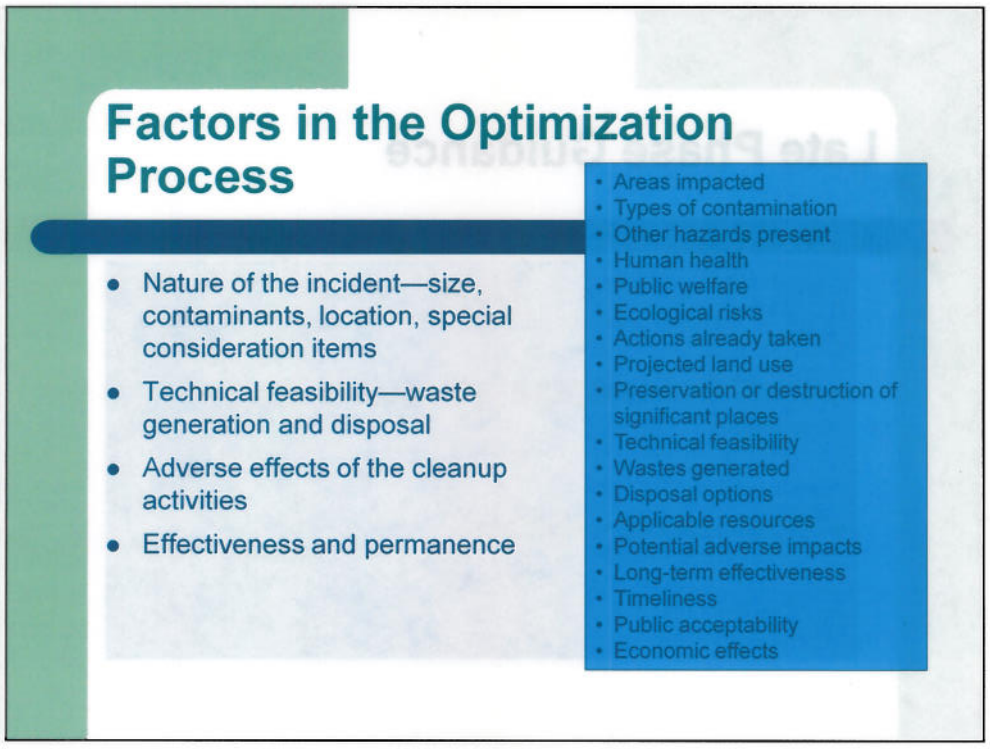
- What kind?
- Where?
- How many?
- How long?



The Department of Homeland Security's RDD and IND Consequence Management Workgroup provided EPA with guidance for the Late Phase. We were on that group and EPA concurred on the guidance.

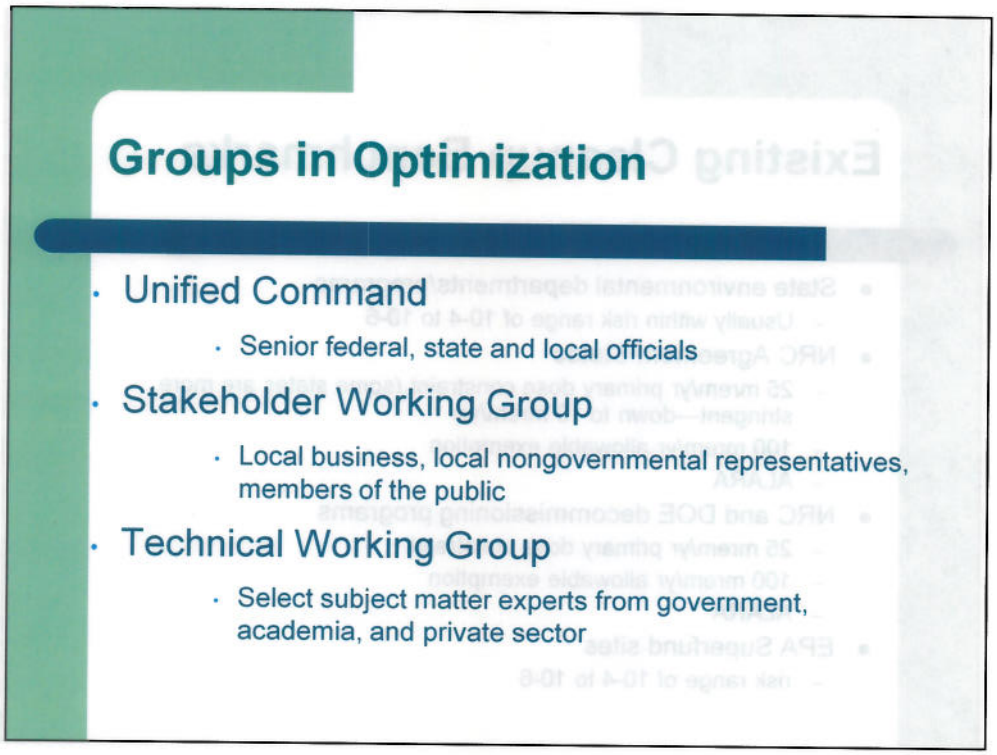
Optimization is a consideration of risk versus benefit -- not limited to just radiation costs in the form of health detriment, but also socio-economic, and numerous factors. Politics! The optimization principle is applied on a case-by-case basis, and numerical radiation criteria for cleanup depend on the specific circumstances of the incident.

Ultimately, work groups will need to balance any number of factors that influence cleanup decisions. Such factors include the size of the area impacted, the type of contamination involved, the type of wastes generated, the economic effects on the area, and the public's willingness to accept any given solution.

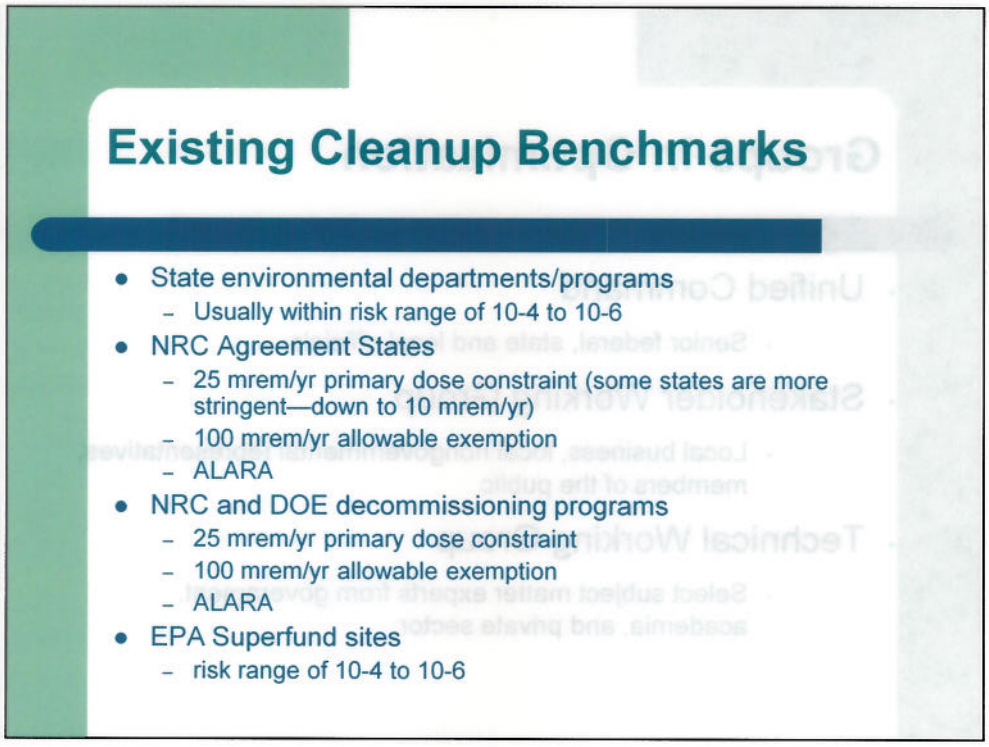


The optimization analysis must consider a number of factors. Among these are the nature of the incident, including such special considerations as historical, religious, and nationally significant items, the technical feasibility of each option, any adverse effects that might arise as a result of cleanup activities, and the effectiveness and permanence over the long term. The box on the right side of the slide lists several considerations.

The evaluation of options for the Late Phase after a radiological incident should take into account many of these factors—such as ecological risks, technical feasibility, and public acceptability. However, in addition to the radiological component, a terrorist event may also require the consideration of biological and chemical contamination



Consensus may be difficult to achieve, but it is essential to the success of the cleanup project. A variety of working groups may be formed at various points in the process to guide and oversee activities. Suggested work groups include a decision team (probably UC or designated by UC), a recovery management team to oversee the field cleanup activities, a stakeholder working group, and a technical working group comprising relevant subject matter experts. Ultimately, the nature of the incident will dictate the number and type of work groups formed. However, in every case, it is critical that members of the affected population and other stakeholders be involved in the process.



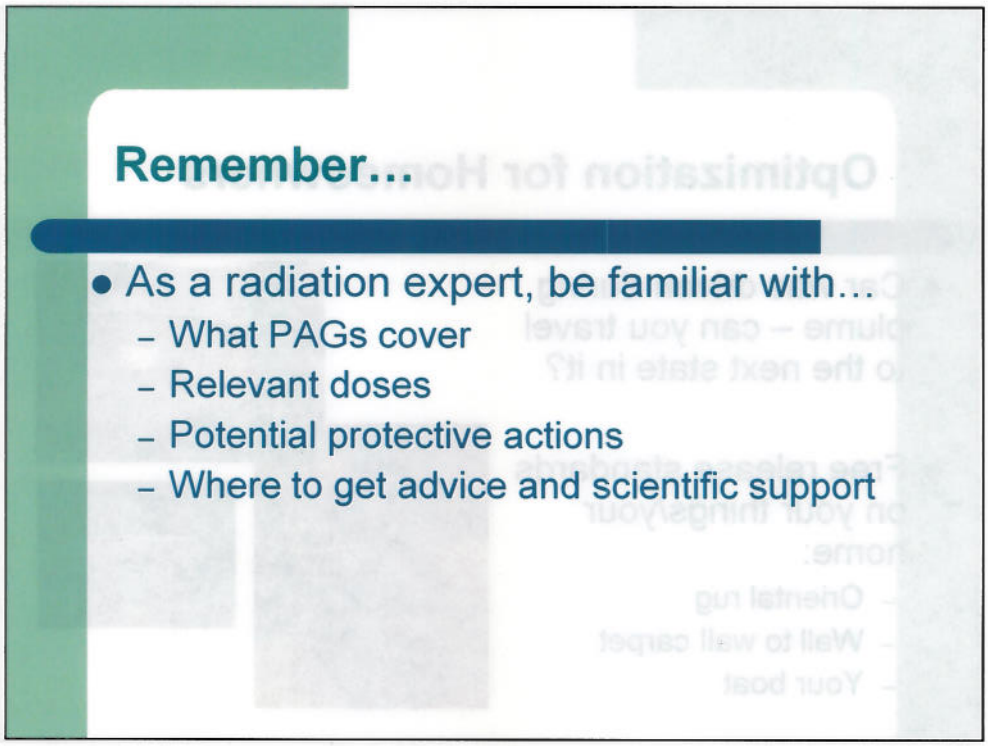
These existing cleanup benchmarks, from a variety of state and federal government agencies, may be considered when determining specific cleanup criteria. I am sure that some of these values are very familiar to some of you in the audience.

Will the process work? We don't get much practice, not for large radiation incidents. We are going to try hard to simulate the process in the exercises Empire 09 and Liberty RadEx.

Optimization for Homeowners

- Car was driven during plume – can you travel to the next state in it?
- Free release standards on your things/your home:
  - Oriental rug
  - Wall to wall carpet
  - Your boat

-If the items are in your home, how does sentimental value figure in?



Just a reminder about what we're trying to focus on… Your Support Role

Offer Potential Protective Actions and Mitigations

Value of Sheltering versus Evacuation

Understand the Sources of Dose

Interpretation of Dose Projections

Properly Apply Dose Avoidance

Where To Get Help

- Advisory Team – 770-488-7100
- FRMAC Home Team – 702-794-1665
- NARAC/IMAAC – 925-422-7627

•You don't have to be like Captain Rad here, holding up collapsing roofs, fighting radiation hazards on your own! You have resources a phone call away…

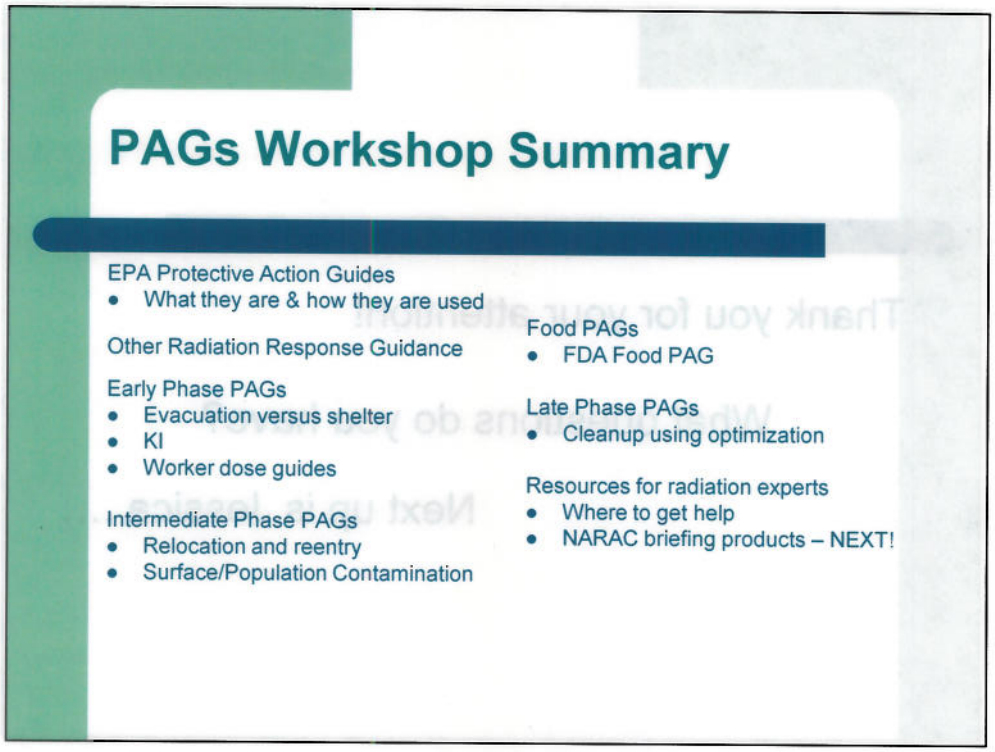
-Even though at drills you might only see two to ten FRMAC people, in a real event they're like "your network" and they'll be there in great numbers to help you!

Requesting EPA RERT Support

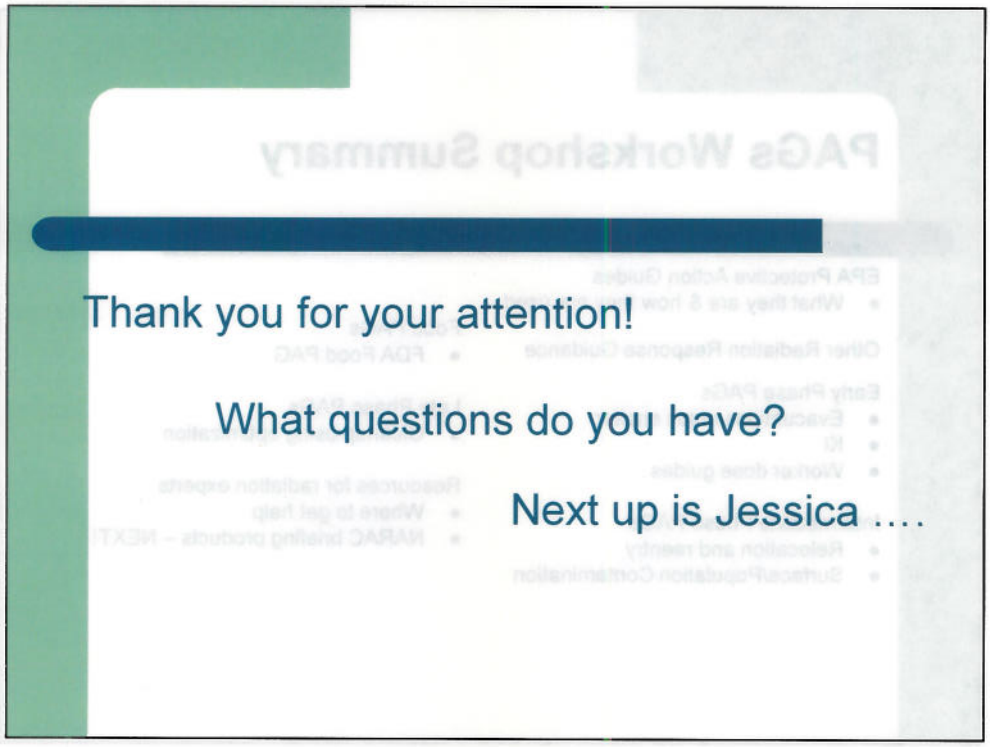
Contact the RERT :

- National Response Center 800-424-8802
  - HQ EOC 202-564-3850
  - Regional Radiation Programs
  - Team Commanders:
    - Sam Poppell 334-546-7214
    - Gregg Dempsey 702-494-7040

- You can get help from us too, by contacting the EPA RERT…….



So we covered these topics -- did we miss anything??



We hope you have found this workshop to be informative and useful. Please fill out the brief survey provided in your handouts. This will help us to improve the workshop for future participants.

Thank you, and now I'll hand it over to Jessica and the NARAC briefing products…